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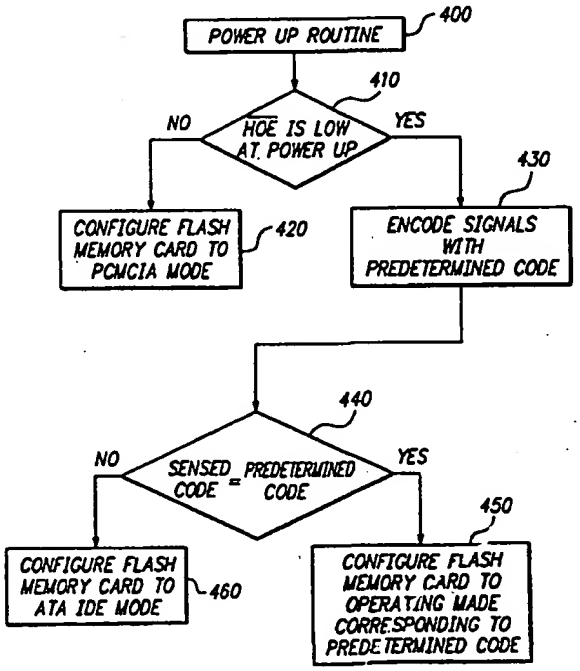
(54) Title: FLASH MEMORY CARD WITH ENHANCED OPERATING MODE DETECTION AND USER-FRIENDLY INTERFACING SYSTEM

(57) Abstract

An interfacing system facilitating user-friendly connectivity in a selected operating mode between a host computer system and a flash memory card. The interfacing system includes an interface device and a flash memory card. The interfacing system features significantly expanded operating mode detection capability within the flash memory card and marked reduction in the incorrect detection of the operating mode. The interface device includes a first end for coupling to the host computer and a second end for coupling to the flash memory card, while supporting communication in the selected operating mode which is also supported by the host computer system. The flash memory card utilizes a fifty pin connection to interface with the host computer system through the interface device. The fifty pin connection of the flash memory card can be used with different interface devices in a variety of configurations such as a universal serial mode, PCMCIA mode, and ATA IDE mode. Each of these modes of operation require different protocols. Upon initialization with the interface device, the flash memory card automatically detects the selected operating mode of the interface device and configures itself to operate with the selected operating mode. The operating mode detection is accomplished by sensing unencoded signals and encoded signals. The encoded signals are encoded with a finite set of predetermined codes. Each predetermined code uniquely identifies a particular operating mode.



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FLASH MEMORY CARD WITH ENHANCED OPERATING MODE DETECTION AND USER-FRIENDLY INTERFACING SYSTEM

Related Application

This Patent Application is a continuation-in-part of commonly owned co-pending US Patent Application Ser. No. 09/034,173, filed March 2, 1998, entitled "Improved Compact Flash Memory Card and Interface", Estakhri et al.

Field of the Invention

This invention relates to the field of flash memory cards and to the field of interfacing systems facilitating user-friendly connectivity between host computer systems and flash memory cards. More particularly, this invention relates to the field of flash memory cards capable of detecting the operating mode of the interface apparatus or host computer system's peripheral port to which the flash memory cards are coupled and of automatically configuring themselves to operate in the detected operating mode.

Background of the Invention

The continual penetration of computer systems into additional markets has been fueled by the emphasis on cost effective user-friendly adaptations for the computer system and on minimizing the amount of resources the user expends configuring the computer system rather than productively utilizing the computer system. Concomitant with the explosion in the popularity of computer systems has seen the proliferation of available externally attachable/detachable peripheral devices for use with the computer system to meet the application demands of the user. One such peripheral is the flash memory card.

A flash memory card is a nonvolatile memory device with a compact housing that does not require a power source in order to retain its memory contents. A typical flash memory card stores charge on a floating gate to represent a first logic state of the binary state system, while the lack of stored charge represents a second logic state of the binary state system. Additionally, the typical flash memory card is capable of performing a write operation, a read operation, and an erase operation.

Flash memory cards can provide "plug and play" capability, low power consumption, portability, and high density storage. Flash memory cards are well suited for digital applications such as digital camera storage, digital audio applications, and wherever

rewritable, digital data storage in a portable housing is needed.

The input/output terminal of the flash memory card is configured to observe one of the prevailing industry standards. This standard requires the input/output terminal to be a fifty pin connector. The flash memory card with its fifty pin connector is designed to fit within either a fifty pin flash socket or, with the addition of a passive adapter, a sixty-eight pin PCMCIA socket. However, most host computer systems do not have either the fifty pin flash socket or the sixty-eight pin PCMCIA socket. If a user wishes to utilize the flash memory card with the host computer system, the user must purchase an expensive PCMCIA socket to connect with the host computer system.

Another deficiency in the current flash memory card market is the inability of the flash memory card to be conveniently configured for operating in the universal serial bus mode, the PCMCIA mode, the ATA IDE mode, or any other protocol for coupling peripheral devices to host computer systems and accessing the peripheral devices. There is a need for a flash memory card that automatically detects and configures itself to the operating mode being utilized by the interface apparatus or host computer system's peripheral port to which the flash memory card is coupled.

The inventors previously proposed a flash memory card and interfacing system to address the current unavailability of automatically configurable flash memory cards. The invention relating to that flash memory card and interfacing system is disclosed in U.S. Patent Application Ser. No. 09/034,173, filed March 2, 1998, entitled "Improved Compact Flash Memory Card and Interface", Estakhri et al., and assigned to assignee of the present invention. That application is incorporated herein by reference.

The inventors' previous flash memory card and interfacing system is shown in Figure 1A. The interfacing system 10 includes a flash memory card interface device 100 and a flash memory card 90 with a fifty pin connector. The flash memory card interface device 100 employs the universal serial bus architecture. The flash memory card interface device 100 includes the following components: a housing 20, a card slot 30, a cable 40, a cable connector 45, and a plug 50. The cable 40 is preferably a standard universal serial bus cable. The plug 50 is configured to easily couple with a universal serial bus port on a host computer system.

Figure 1B illustrates a bottom cutaway view of the housing 20 in the flash memory card interface device 100. Figure 1C illustrates a perspective cutaways view of the flash

memory card interface device 100. A card receiver housing 130 is attached to the bottom plate 110. Additionally, a plurality of contact pins 160 are coupled to the card receiver housing 130, preferably, fifty contact pins. The card receiver housing 130 is configured to couple and hold the flash memory card 90 as the flash memory card 90 is inserted through the slot opening 30 in the housing 20 as shown in Figure 1A. Further, the plurality of contact pins 160 are configured to electrically couple with the corresponding pins (not shown) on the flash memory card 90.

In operation, one end of flash memory card interface device 100 is coupled to a host computer system (not shown) via the plug 50 and the other end of the flash memory card interface device 100 is coupled to the flash memory card 90 via the card receiver housing 130, a fifty pin connection.

The inventors' previous flash memory card 90 detected the operating mode of the interface device 100 to which the previous flash memory card was coupled and configured itself to the appropriate operating mode by using an internal controller and a sensing means coupled to the internal controller. Figure 2 illustrates a flowchart diagram which represents the procedure the internal controller of the previous flash memory card 90 could follow in detecting the operating mode of the interface device 100 to which the previous flash memory card 90 was coupled. The fundamental mechanism utilized by the internal controller for detecting the operating mode consists solely of sensing signals at the fifty pin connector of the previous flash memory card 90. At the fifty pin connector, the internal controller does not alter or add signals, but simply senses the signals.

The operating mode detection sequence begins with the previous flash memory card 90 being coupled to the flash memory card interface device 100, which is coupled to the host computer system, then proceeding to the BLOCK 200 routine of powering up the previous flash memory card 90. After the power up sequence in BLOCK 200, the signal at the HOE__ pin terminal of the previous flash memory card 90 is sensed in BLOCK 210. If the signal at the HOE__ pin terminal is a logic HIGH, then proceeding to BLOCK 220 the internal controller configures the previous flash memory card 90 into the PCMCIA mode. However, if the signal at the HOE__ pin terminal is logic LOW, then proceeding to BLOCK 230 the signal at the HOSTRESET____ pin terminal is sensed. If the signal at the HOSTRESET__ pin terminal is logic LOW, then the operating mode detection sequence returns to BLOCK 230 and senses the signal at the HOSTRESET__ pin terminal

again. If the signal at the HOSTRESET__ pin terminal remains logic LOW, then the operating mode detection sequence continues to loop back to BLOCK 230 until the HOSTRESET____ pin terminal switches to logic HIGH. If the signal at the HOSTRESET___ pin terminal is logic HIGH, then proceeding to BLOCK 240 the signals at pin terminals IOW_, IOR_, HCE1_, and HCE2_ are sensed. If all of these signals are logic LOW, then proceeding to BLOCK 250 the internal controller configures the previous flash memory card 90 into the universal serial bus mode. If any of these signals are logic HIGH, then proceeding to BLOCK 260 the internal controller configures the previous flash memory card 90 into the ATA IDE mode.

Unfortunately, since the previous flash memory card 90 relies solely on sensing particular signals at particular pin terminals, the previous flash memory card 90 is limited as to the number of different operating modes it is capable of detecting. In addition, reliance on sensing a few pin terminals is susceptible to detecting an incorrect operating mode because a single missensed signal could cause the previous flash memory card 90 to be configured to the incorrect operating mode.

What is needed is a flash memory card capable of detecting a large number of different operating modes. What is further needed is a flash memory card capable of accurately and automatically detecting the operating mode of the interface device or host computer system's peripheral port to which the flash memory card is coupled and of configuring itself to the detected operating mode. What is further needed is an interfacing system which simplifies both the attachment to host computer systems and configuration of flash memory cards from the end-user perspective.

Summary of the Invention

The present invention is a flash memory card interfacing system for connecting in a selected operating mode a flash memory card to a host computer system. The flash memory card interfacing system represents a low cost user friendly adaptation for coupling and configuring flash memory cards as peripheral devices to host computer systems while simplifying the end user's involvement in this coupling and configuration process. In addition to simplifying the connection of flash memory cards to host computer systems, the flash memory card interfacing system's key features include: significantly expanded operating mode detection capability within the flash memory card and marked reduction in the incorrect detection of operating modes.

The flash memory card interfacing system has an interface device and a flash memory card.

The flash memory card has a fifty pin connecting terminal for coupling to the computer system through the interface device. In addition, the flash memory card comprises: a flash memory module, a controller, an encoding circuitry, and a sensing circuitry.

The flash memory card is functionally ready to conduct data storage operations for the host computer system within a short period of being coupled to the computer system through the interface device. Attaining this quick operational readiness is achieved by having the flash memory card execute, immediately after initial communication with the interface device, a sequential procedure for identifying the selected operating mode of the interface device. After identifying the selected operating mode, the flash memory card automatically configures itself to the selected operating mode without receiving configuration data from an external source. Interface devices employing operating modes such as the universal serial bus mode, the PCMCIA mode, and the ATA IDE mode can functionally operate with the flash memory card. In addition, interface devices utilizing other protocols for attaching and accessing peripheral devices can also functionally operate with the flash memory card without much difficulty.

The expanded operating mode detection capability of the flash memory card, once coupled in a selected operating mode to the host computer system through the interface device, is accomplished by dedicating a plurality of signals originating from the host computer system to an encoding procedure formulated to identify an increased number of operating modes. By encoding the plurality of signals with a predetermined code and then sensing the applied predetermined code, the flash memory card can identify the selected operating mode by observing changes between the predetermined code applied to the plurality of signals and the code actually sensed from the plurality of signals. Since each operating mode is assigned a unique code, discrepancy between the predetermined code and the sensed code indicates the selected operating mode differs from the operating mode assigned to the predetermined code applied to the plurality of signals. The flash memory card applies a different predetermined code until the selected operating code is identified.

Brief Description of the Drawings

Figure 1A illustrates a perspective view of the preferred embodiment of the prior

invention.

Figure 1B illustrates a bottom cutaway view of the preferred embodiment of the prior invention.

Figure 1C illustrates a perspective inside view of the preferred embodiment of the prior invention.

Figure 2 shows a flowchart diagram of the preferred embodiment of the prior invention.

Figure 3 illustrates a schematic block diagram of the preferred embodiment of the present invention coupled to a host computer system.

Figure 4 shows a flowchart diagram of the preferred embodiment of the present invention.

Detailed Description of the Preferred Embodiment

The flash memory card interfacing system of the present invention simplifies from the end user's perspective the process of coupling and configuring in a selected operating mode a flash memory card to a host computer system as a peripheral device. This process of coupling and configuring the flash memory card is reduced to steps easily understandable to both the novice end user and the technically proficient end user. Initially, a first end of an interface device is coupled to the host computer system, while the flash memory card is coupled to a second end of the interface device. The flash memory card is then powered by the host computer system or a different power source. Finally, the flash memory card automatically detects the selected operating mode of the interface device and configures itself to function in the selected operating mode. The identification of the selected operating mode involves sequentially processing signals originating from the host computer system until the selected operating mode is identified. From the end user's perspective, the configuration of the flash memory card proceeds without the end user sending configuration instructions to the flash memory card or manipulating computer hardware settings.

A schematic block diagram of the preferred embodiment of the present invention coupled to a host computer system is illustrated in Figure 3. This flash memory card interfacing system 300 includes an interface device 310 and a flash memory card 320.

The interface device 310 preferably includes a first end 314 and a second end 315. The first end 314 is configured for coupling to the host computer system 330. The second end 315 is configured for coupling to the flash memory card 320. In addition, for more efficient communication between the flash memory card 320 and the host computer system 330, the second end 315 is configured to support a fifty pin connection. The first end 314 and the second end 315 support communication in a selected operating mode which is also supported by the host computer system's peripheral port 335. Each selected operating mode is associated with a unique protocol for coupling and accessing peripheral devices. The interface device 310 can be implemented in a variety of protocols that are known to those skilled in the art. The protocols: universal serial bus, PCMCIA, and ATA IDE, are only a few examples of the available protocols for attaching and accessing peripheral devices to the host computer system 330. To maximize the low cost user-friendliness feature of the flash memory card interfacing system 300, the interface device 310 preferably employs the universal serial bus protocol. The universal serial bus protocol provides a fast bi-directional isochronous transfer of data between external peripheral devices and the host computer system 330 at very low cost.

In practice, the interface device 310 preferably couples to the host computer system 330 via the first end 314, while the second end 315 is coupled to the flash memory card 320. Eliminating and/or combining certain elements shown in the interface device 310 would be apparent to a person skilled in the art and would not depart from the scope of the present invention.

The flash memory card preferably includes a flash memory module 326, a controller 327, an encoding circuitry 328, and a sensing circuitry 329. The flash memory module 326 is capable of executing a write operation, a read operation, and an erase operation. The controller 327 is electrically coupled to the flash memory module 326. In addition, the controller 327 configures the flash memory card 320 to the selected operating mode of the interface device 310. The encoding circuitry 328 and the sensing circuitry 329 are electrically coupled to the controller 327. Both the encoding circuitry 328 and the sensing circuitry 329 perform the task of identifying the selected operating mode of the interface device 310. This identification circuitry can be physically formed on the flash memory card 320 or in an adapter module coupled between the flash memory card 320 and the second end 315 of the interface device 310.

The flash memory card 320 preferably includes a fifty pin connector end 325 as illustrated in Figure 3. The fifty pins serve as input/output and control terminals for the flash memory card 320 and carry signals. However, the extent that a pin is utilized in communicating with the host computer system 330 depends on the selected operating mode to which the flash memory card 320 is configured. For example, in the ATA IDE operating mode, the pin terminals labelled HA0, HA1, and HA2 are actively transmitting signals from the host computer system 320, but the pin terminals labelled HA3, HA4, HA5, HA6, HA7, HA8, HA9, and HA10 are inactive. For identifying the selected operating mode, the flash memory card 320 implements a sequential procedure that utilizes the signals at inactive pins for detection of the selected operating mode. This sequential procedure allows the flash memory card 320 to accurately detect a large variety of operating modes and gives the flash memory card 320 the versatility to detect operating modes yet to be developed.

Figure 4 illustrates a flowchart diagram which represents a sample sequence of steps the controller 327 of the flash memory card 320 executes in determining the selected operating mode of the interface device 310. The operating mode detection sequence begins with the flash memory card 320 being coupled to the interface device 310, which is coupled to the host computer system 330, then proceeding to the BLOCK 400 routine of powering up the flash memory card 320. After the power up sequence in BLOCK 400, the signal at the HOE__ pin terminal of the flash memory card 320 is sensed in BLOCK 410. The signal at the HOE__ pin terminal originates from the host computer system 330. If the signal at the HOE__ pin terminal is a logic HIGH, then proceeding to BLOCK 420 the controller 327 configures the flash memory card 320 into the PCMCIA mode. However, if the signal at the HOE___ pin terminal is a logic LOW, then proceeding to BLOCK 430 preencoded signals at pin terminals labelled HA3, HA4, HA5, HA6, HA7, HA8, HA9, and HA10 are encoded with a predetermined code which uniquely identifies an operating mode. The preencoded signals are encoded on the flash memory card 320. This encoding process transforms the preencoded signals into encoded signals. Continuing to BLOCK 440, the encoded signals are sensed. If the encoded signals retain the predetermined code, proceeding to BLOCK 450 the controller 327 configures the flash memory card 320 to the operating mode corresponding to the predetermined code. However, if the encoded signals do not retain the predetermined code, then the operating mode detection sequence proceeds

to BLOCK 460 where the controller 327 configures the flash memory card 320 into the ATA IDE mode.

These specifically named operating modes are merely exemplary. The flash memory card 320 can be configured to automatically detect and operate in additional operating modes.

To facilitate the detection of the selected operating mode, the controller 327 preferably configures the flash memory card 320 into a preliminary operating mode before proceeding to the encoding sequence of BLOCK 430. Preferably, the preliminary operating mode is the ATA IDE mode. Configuring the flash memory card 320 into the preliminary operating mode assists the encoding process, but does not affect the operating mode detection procedure.

The predetermined code that uniquely identifies an operating mode is chosen such that to minimize the detection of an incorrect operating mode. Each predetermined code is different from every other predetermined code. The length of the predetermined code preferably corresponds to the number of signals that are scheduled for encoding. The controller 327 of the flash memory card 320 is preferably programmed with the finite set of predetermined codes. Alternatively, the finite set of predetermined codes can be programmed in an adapter module coupled between the flash memory card 320 and the second end 315 of the interface device 310.

Although the preferred embodiment employs signals at pin terminals labelled HA3, HA4, HA5, HA6, HA7, HA8, HA9, and HA10 of the ATA IDE operating mode for encoding purposes, employing different signals at different pin terminals of a variety of other operating modes would not depart from the spirit and scope of the present invention. Additionally, reducing or enlarging the number of signals utilized for detecting the operating mode would not depart from the spirit and scope of the present invention.

The present invention has been described in terms of specific embodiments incorporating details to facilitate the understanding of the principles of construction and operation of the invention. Such reference herein to specific embodiments and details thereof is not intended to limit the scope of the claims appended hereto. It will be apparent to those skilled in the art that modifications may be made in the embodiments chosen for illustration without departing from the spirit and scope of the invention.

Specifically, it will be apparent to one of ordinary skill in the art that the device of the present invention could be implemented in several different ways and the apparatus disclosed above is only illustrative of the preferred embodiment of the invention and is in no way a limitation. For instance, the flash memory card interfacing system could be implemented with a variety of peripheral devices other than the flash memory card.

In the Claims:

1. A flash memory card for coupling to a host computer system and performing data storage operations in plurality of selected operating modes without requiring configuration instructions from an external source, the flash memory card comprising:

a. a flash memory module for executing a write operation, a read operation, and an erase operation;

b. a controller coupled to the flash memory module, the controller processing an unencoded signal originating from the host computer system and an encoded signal in the flash memory card and configuring the flash memory card to the selected operating mode in response to the unencoded signal and the encoded signal;

c. encoding means for applying to a preencoded signal originating from the host computer system a finite set of predetermined codes, each predetermined code uniquely identifying an operating mode, thereby transforming the preencoded signal into the encoded signal, the encoding means being coupled to the controller; and

d. sensing means for monitoring the unencoded signal and the encoded signal, the sensing means being coupled to the controller.

2. The flash memory card according to claim 1 wherein the finite set of predetermined codes is programmed into the controller.

3. The flash memory card according to claim 1 wherein the encoded signal is an ATA IDE operating mode signal pin selected from HA3, HA4, HA5, HA6, HA7, HA8, HA9, and HA10.

4. The flash memory card according to claim 1 further comprising a fifty pin connector end configured to couple to an interface device.

5. The flash memory card according to claim 1 further comprising a sixty-eight pin connector end configured to couple to an interface device.

6. An interfacing system for coupling a peripheral device to a host computer system supporting communication in a selected operating mode with the peripheral device and for allowing the peripheral device to automatically detect and configure the peripheral device to utilize the selected operating mode, the interfacing system comprising:

a. an interface device having a first end configured for coupling to the host computer system and a second end configured for coupling to the peripheral device, wherein the first end and the second end support communication in the selected operating mode;

b. a controller integrated into the peripheral device, the controller processing an unencoded signal originating from the host computer system and an encoded signal in the peripheral device and configuring the peripheral device to the selected operating mode in response to the unencoded signal and the encoded signal;

c. encoding means for applying to a preencoded signal originating from the host computer system a finite set of predetermined codes, each predetermined code uniquely identifying an operating mode, thereby transforming the preencoded signal into the encoded signal, the encoding means being coupled to the controller; and

d. sensing means for monitoring the unencoded signal and the encoded signal, the sensing means being coupled to the controller.

7. The interfacing system according to claim 6 wherein the finite set of predetermined codes is programmed into the controller.

8. The interfacing system according to claim 6 wherein the peripheral device is a flash memory card.

9. The interfacing system according to claim 8 wherein the encoded signal is an ATA IDE operating mode signal pin selected from HA3, HA4, HA5, HA6, HA7, HA8, HA9, and HA10.

10. The interfacing system according to claim 6 wherein the second end of the interface device supports a fifty pin connection.

11. The interfacing system according to claim 6 wherein the second end of the interface device supports a sixty-eight pin connection.

12. The interfacing system according to claim 6 wherein the interface device is implemented as a PCMCIA interface.

13. The interfacing system according to claim 6 wherein the interface device is implemented as an ATA IDE interface.

14. The interfacing system according to claim 6 wherein the interface device is implemented as a universal serial bus interface.

15. A method of automatically configuring a peripheral device to communicate with a host computer system in a selected operating mode, comprising the following steps:

a. coupling the peripheral device to the host computer system, the coupling step establishing a communication channel between the peripheral device and the computer system;

b. powering the peripheral device;

c. sequentially analyzing within the peripheral device plurality of signals until the selected operating mode is identified; and

d. automatically configuring the peripheral device into the selected operating mode in response to the signals.

16. The method according to claim 15 wherein the step of sequentially analyzing the signals includes the following steps:

a. sensing within the peripheral device an encoded signal originating from the host computer system and an unencoded signal originating from the host computer system; and

b. encoding a preencoded signal originating from the host computer system with a finite set of predetermined codes, each predetermined code uniquely identifying an operating mode, thereby transforming the preencoded signal into the encoded signal.

17. The method according to claim 16 further comprising the step of configuring the peripheral device into a preliminary operating mode before the step of encoding the preencoded signal.

18. The method according to claim 17 wherein the preliminary operating mode is an ATA IDE mode.

19. The method according to claim 15 wherein the peripheral device is a flash memory card.

20. The method according to claim 19 wherein the encoded signal is an ATA IDE operating mode signal pin selected from HA3, HA4, HA5, HA6, HA7, HA8, HA9, and HA10.

21. The method according to claim 15 wherein the selected operating mode is a PCMCIA mode.

22. The method according to claim 15 wherein the selected operating mode is a universal serial bus mode.

23. The method according to claim 15 wherein the selected operating mode is an ATA IDE mode.

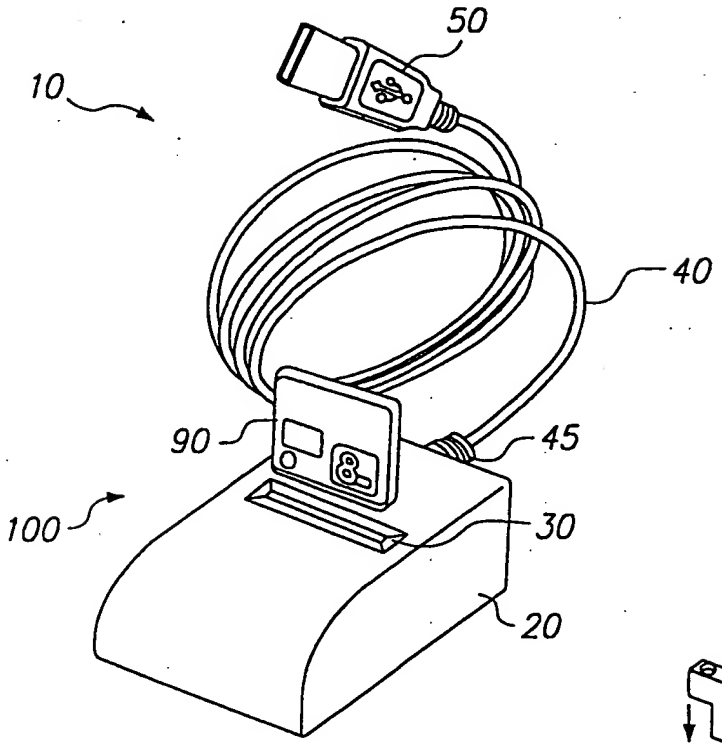

FIG. 1A

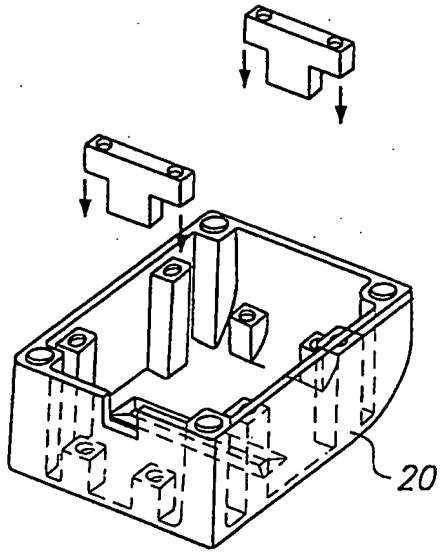

FIG. 1B

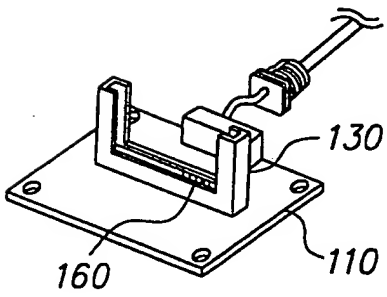

FIG. 1C

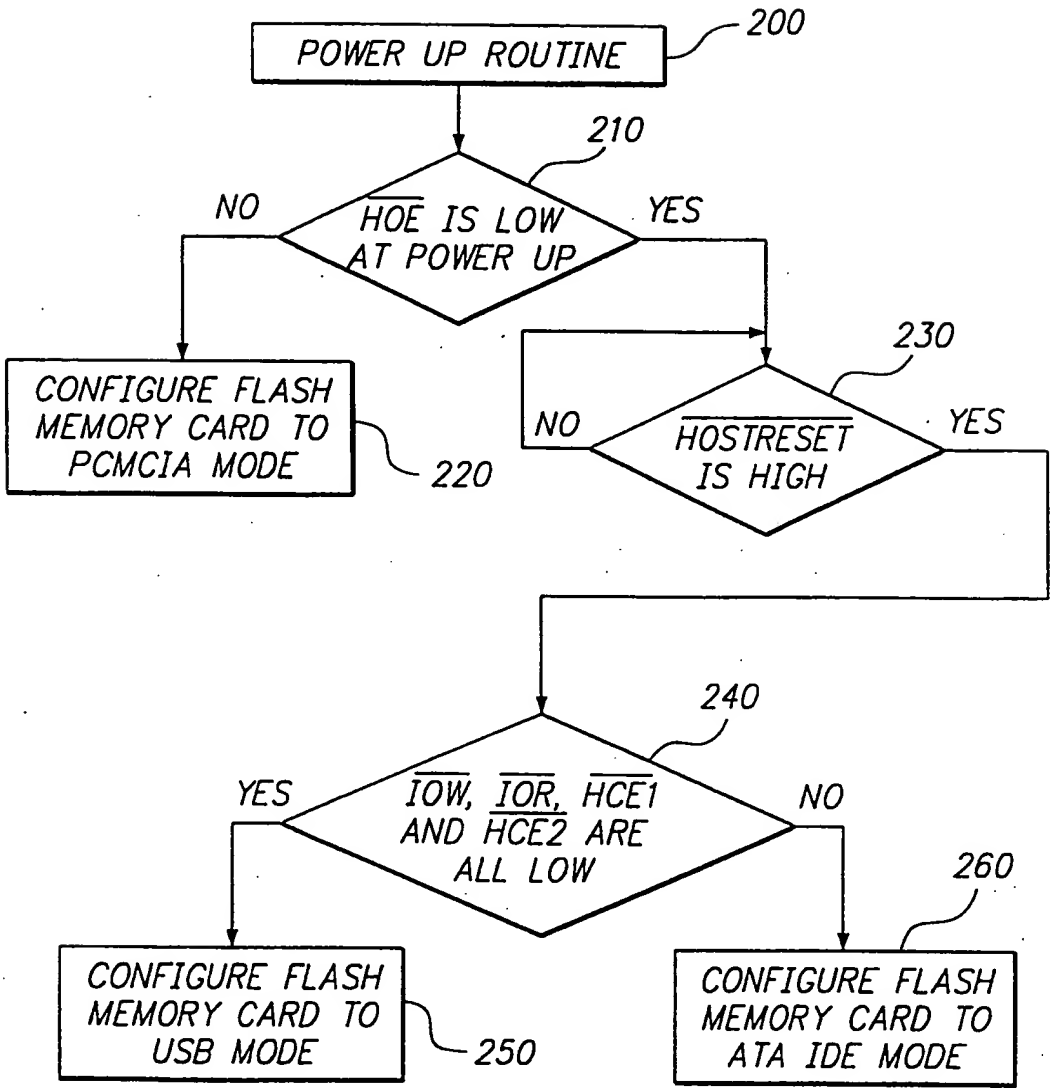
POWER UP ROUTINE
200
210
HOE IS LOW AT POWER UP
NO
YES
CONFIGURE FLASH MEMORY CARD TO PCMCIA MODE
220
230
HOSTRESET IS HIGH
NO
YES
240
IOW, IOR, HCE1 AND HCE2 ARE ALL LOW
YES
NO
CONFIGURE FLASH MEMORY CARD TO USB MODE
250
260
CONFIGURE FLASH MEMORY CARD TO ATA IDE MODE

FIG. 2

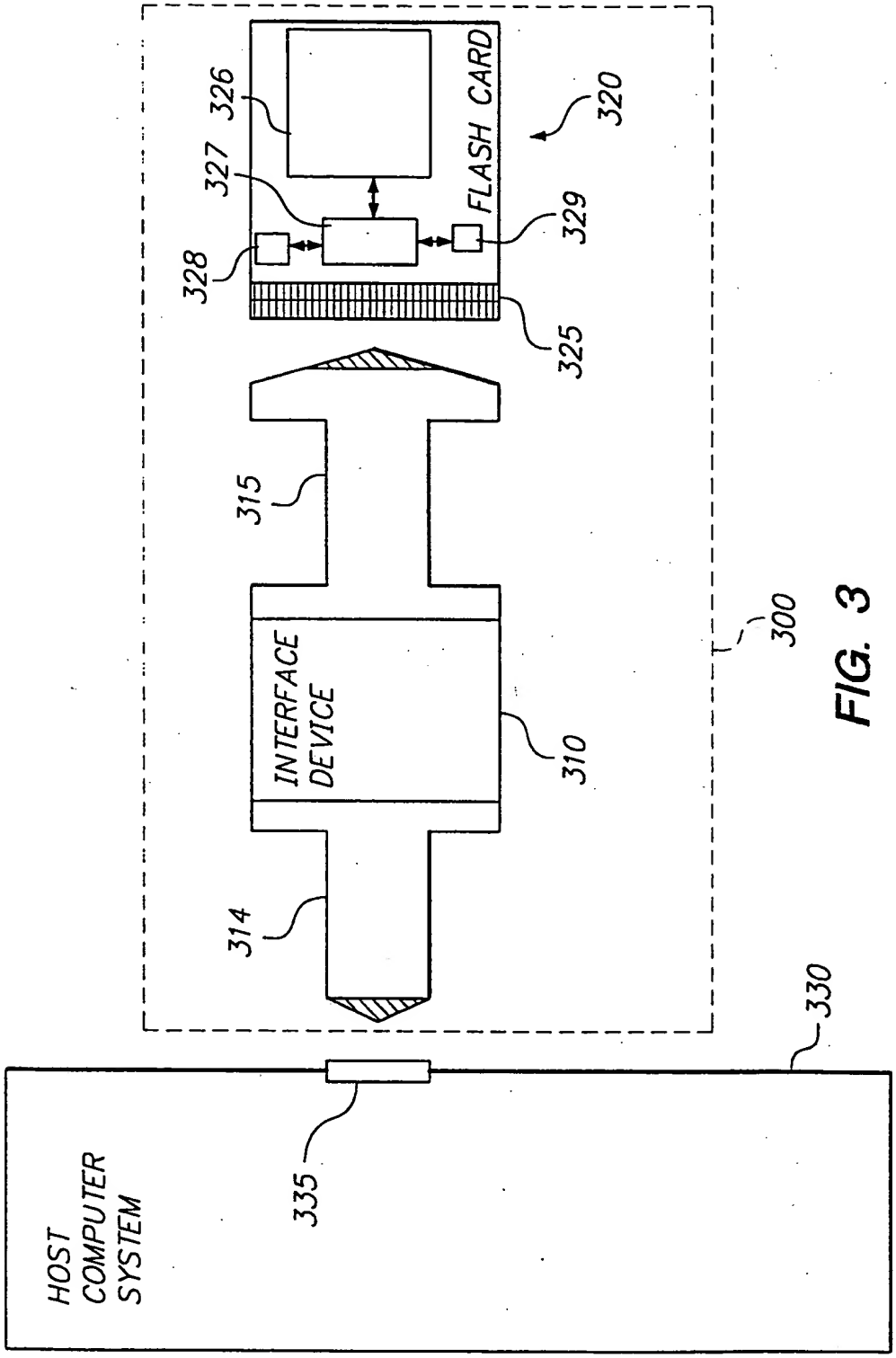
FLASH CARD
320
326
327
328
329
325
315
INTERFACE DEVICE
310
314
300
330
335
HOST COMPUTER SYSTEM

FIG. 3

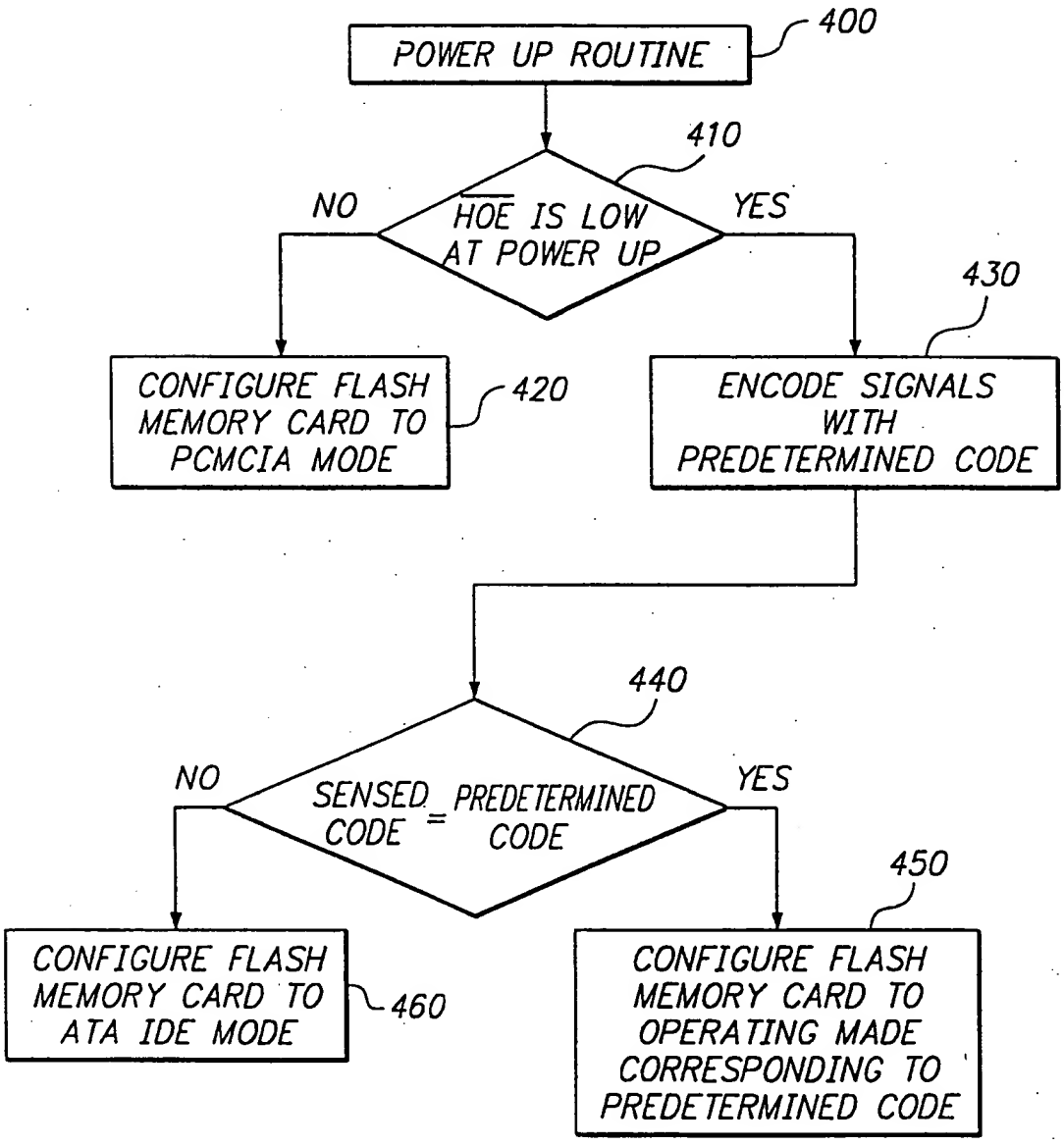
POWER UP ROUTINE
400
410
HOE IS LOW AT POWER UP
NO
YES
CONFIGURE FLASH MEMORY CARD TO PCMCIA MODE
420
430
ENCODE SIGNALS WITH PREDETERMINED CODE
440
SENSED CODE = PREDETERMINED CODE
NO
YES
CONFIGURE FLASH MEMORY CARD TO ATA IDE MODE
460
450
CONFIGURE FLASH MEMORY CARD TO OPERATING MADE CORRESPONDING TO PREDETERMINED CODE

FIG. 4

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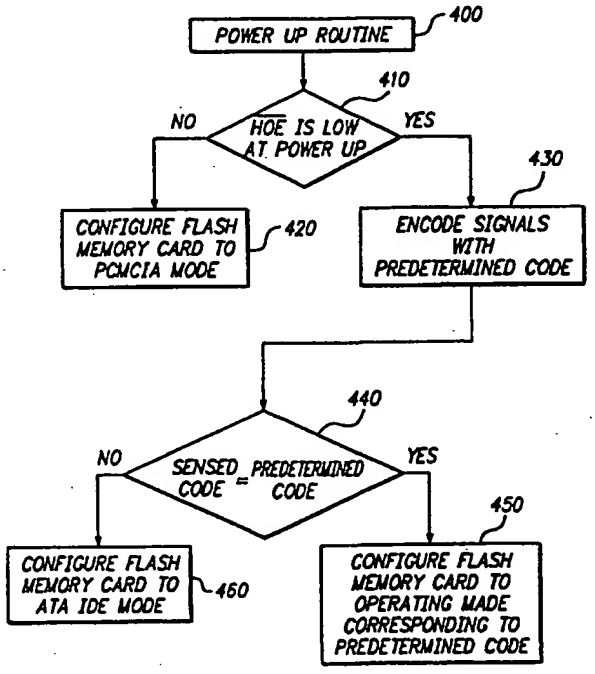
(57) Abstract

An interfacing system facilitating user–friendly connectivity in a selected operating mode between a host computer system and a flash memory card. The interfacing system includes an interface device and a flash memory card. The interfacing system features significantly expanded operating mode detection capability within the flash memory card and marked reduction in the incorrect detection of the operating mode. The interface device includes a first end for coupling to the host computer and a second end for coupling to the flash memory card, while supporting communication in the selected operating mode which is also supported by the host computer system. The flash memory card utilizes a fifty pin connection to interface with the host computer system through the interface device. The fifty pin connection of the flash memory card can be used with different interface devices in a variety of configurations such as a universal serial mode, PCMCIA mode, and ATA IDE mode. Each of these modes of operation require different protocols. Upon initialization with the interface device, the flash memory card automatically detects the selected operating mode of the interface device and configures itself to operate with the selected operating mode. The operating mode detection is accomplished by sensing unencoded signals and encoded signals. The encoded signals are encoded with a finite set of predetermined codes. Each predetermined code uniquely identifies a particular operating mode.



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INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/US 99/04633

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06F13/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 625 238 A (ADY ROGER W ET AL) 29 April 1997 (1997-04-29) column 1, line 11 - line 46 column 2, line 23 - line 51 column 2, line 61 - column 3, line 39 column 4, line 6 - line 13 column 6, line 37 - column 7, line 4 abstract; claims 1-3; figures 1,4A-4B ---	1-20
A	US 5 589 719 A (FISET PETER D) 31 December 1996 (1996-12-31) column 1, line 11 - column 2, line 62 column 4, line 2 - column 5, line 13 column 6, line 23 - column 7, line 15 column 9, line 17 - column 10, line 12 abstract; figures 1,12 --- -/--	1-20

[X] Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
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PCT/US 99/04633

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 628 908 A (AT & T CORP) 14 December 1994 (1994-12-14) column 1, line 18 - line 44 column 3, line 55 - column 5, line 31 abstract	1-20

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INTERNATIONAL SEARCH REPORT

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